PROJECT

ON

ANALYSIS OF SACHET WATER QUALITY IN KWARA STATE POLYTECHNIC.

BY:

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CERTIFICATION

This is to certify that this project work was carried out by **ALADE MONSHKUROH ARINOLA** with the Matriculation Number **ND/23/SLT/PT/0491**. This project has been read and approved as meeting part of the requirement for the award of National Diploma (ND) in science laboratory technology, Kwara State Polytechnic, Ilorin.

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DEDICATION

I dedicated this project work to my lord, my creator, the almighty God who gave me the privilege to finish the report successful and to my parent. Mr. and Mrs. Alade that support me financially and with prayer.

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Glory to almighty God the lord of the world. Who has been through his mercy for sparing my life till today.

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ABSTRACT

Access to safe and clean drinking water remains a critical challenge in many developing nations, including Nigeria. In response to the inconsistent public water supply, sachet water commonly referred to as "pure water" has become a widely consumed alternative among urban populations. In tertiary institutions such as Kwara State Polytechnic, Ilorin, sachet water is the primary source of drinking water for students, staff, and residents of the surrounding community. Despite its popularity and perceived convenience, concerns persist regarding the safety and quality of sachet water, especially given reports of contamination and inadequate regulation in parts of Nigeria.

This study aimed to analyze the physicochemical quality of sachet water consumed within the Kwara State Polytechnic community to assess its compliance with World Health Organization (WHO) and Standards Organization of Nigeria (SON) drinking water standards. Ten popular sachet water brands were randomly selected and subjected to laboratory testing for key parameters including pH, turbidity, electrical conductivity, total dissolved solids (TDS), total hardness, calcium, magnesium, nitrate, and chloride. The study adopted a descriptive and analytical survey design, using standard laboratory methods outlined by the American Public Health Association (APHA) for data collection and analysis.

The results showed that most sachet water brands conformed to acceptable WHO/SON standards. Parameters such as pH ranged from 6.4 to 7.2, turbidity from 0.2 to 1.3 NTU, and TDS from 80 to 270 mg/L all within safe limits. However, a few brands showed borderline values in hardness and calcium content, indicating variability in production quality and possible mineral leaching from source water. No significant exceedance was recorded for nitrate or chloride, suggesting proper source selection and treatment in most cases.

The study concluded that sachet water in Kwara State Polytechnic is largely safe for consumption in terms of physicochemical composition, although inconsistencies between brands highlight the need for continuous monitoring and stricter quality assurance by regulatory bodies. Recommendations include routine inspections, public awareness campaigns, and the need for improved transparency from sachet water producers. This research contributes to the body of knowledge on water safety in academic environments and underscores the importance of quality control in protecting public health.

CHAPTER ONE

1.0 Introduction

Water is an essential component of life, fundamental to health, hygiene, food security, and sustainable development. According to the World Health Organization (WHO, 2017), access to safe and clean drinking water is a basic human right, and the lack of it constitutes a major risk to health and well-being. In many developing countries, including Nigeria, the increasing urban population and inadequate municipal water supply have led to a surge in the consumption of sachet water, popularly referred to as "pure water" (Omalu et al., 2010). Sachet water has emerged as a vital alternative for drinking water, especially in urban and peri-urban communities such as that of Kwara State Polytechnic, Ilorin.

Kwara State Polytechnic is one of the prominent tertiary institutions in North-Central Nigeria, with a dense population of students and staff who depend largely on sachet water for daily consumption due to the unreliable nature of pipe-borne water on campus and in nearby hostels. The affordability, accessibility, and portability of sachet water make it the preferred choice. However, concerns about its microbiological and physicochemical quality have sparked debates and drawn attention from public health experts and regulatory bodies alike (Osei et al., 2014). Several studies across Nigeria have identified sachet water contamination with bacteria such as *Escherichia coli*, *Salmonella spp.*, and *Shigella spp.*, primarily due to poor hygiene practices, substandard packaging, and lack of regulatory enforcement (Adekunle et al., 2004; Okonko et al., 2008).

The increasing reliance on sachet water in the Kwara State Polytechnic community necessitates a thorough investigation into its quality. While sachet water is often assumed to be safe because it is packaged, this assumption can be misleading without empirical verification. Contaminated sachet water poses severe health risks, including waterborne diseases such as diarrhea, typhoid, and cholera, which are especially dangerous in crowded academic environments (Adefisoye & Okoh, 2016).

This research seeks to critically analyze the quality of sachet water consumed within the Kwara State Polytechnic, Ilorin community, using both microbiological and physicochemical parameters. The study will examine commonly available brands, assess compliance with standards set by

regulatory agencies such as the National Agency for Food and Drug Administration and Control (NAFDAC) and WHO, and identify possible lapses in production and distribution that may compromise safety.

Understanding the quality of sachet water in this context will not only inform consumer choices but also help in developing policies for improved water safety and student health. It will also provide empirical data that could be useful to campus health services, environmental health officers, and policy makers.

In sum, this study is driven by the urgent need to safeguard public health in the Kwara State Polytechnic community and contribute to broader discourse on water quality and safety in Nigeria.

1.1 Statement of the Problem

Access to safe and clean drinking water remains a persistent challenge in many developing regions, including Nigeria. Although water is essential for survival and health, the increasing scarcity of safe, potable water has driven many urban and semi-urban dwellers, including students and staff in tertiary institutions, toward alternative sources such as sachet water. In Kwara State Polytechnic, Ilorin, a large proportion of the school community relies on sachet water for their daily hydration needs due to the irregularity and unreliability of public water supply.

Despite the widespread consumption of sachet water, the actual quality of these products is often uncertain. Numerous studies across Nigeria have revealed that many sachet water brands do not meet the microbiological and physicochemical safety standards set by national and international regulatory bodies (Adekunle et al., 2004; Omalu et al., 2010). Inconsistent production practices, unhygienic packaging environments, improper handling during distribution, and lack of effective regulatory monitoring contribute significantly to the contamination of sachet water. This poses a serious public health risk to consumers, especially within institutions like Kwara State Polytechnic, where a high concentration of people increases the likelihood of communicable disease outbreaks.

Despite this growing concern, there appears to be a limited body of research focused specifically on sachet water quality within the Kwara State Polytechnic campus. Most existing studies are generalized across larger urban areas, leaving a gap in location-specific evidence. As a result,

students and staff remain vulnerable, unaware of the potential health hazards associated with the sachet water they consume daily.

The absence of comprehensive local data on water quality has created a significant barrier to targeted interventions and informed decision-making. It is, therefore, critical to assess the bacteriological and physicochemical safety of sachet water available within the Kwara State Polytechnic environment. This study seeks to bridge that gap by providing empirical evidence that will help protect the health of the institution's community while contributing to national conversations on water quality assurance and policy enforcement.

1.2 Justification of the Research

The choice of this study is based on the growing reliance on sachet water as a primary source of drinking water among members of the Kwara State Polytechnic community. With the failure of conventional water supply systems and the affordability of sachet water, most students, staff, and visitors consume multiple sachets daily, believing them to be clean and safe. However, numerous reports and studies across Nigeria have shown that not all sachet water brands conform to hygienic production standards or meet safety regulations (Okonko et al., 2008; Adefisoye & Okoh, 2016). This highlights a public health concern that must be addressed at the institutional level.

Academically, this research contributes to the field of environmental health, microbiology, and public safety. It provides relevant local data that can support further academic inquiry and policy advocacy. Overall, this study is justified not only by its potential to protect the health of the Kwara State Polytechnic community but also by its broader implications for public health and sustainable water safety practices in Nigeria.

1.3 Aim of the Study

The aim of this study is to critically assess the microbiological and physicochemical quality of sachet water consumed within the Kwara State Polytechnic, Ilorin community, in order to determine its safety for human consumption and evaluate its compliance with national and international water quality standards.

1.4 Objectives of the Study

1. To identify and collect the most commonly consumed sachet water brands within the Kwara State Polytechnic, Ilorin community.

2. To examine the physicochemical parameters (such as pH, turbidity, conductivity, and total dissolved solids) of selected sachet water samples.

3. To analyze the microbiological content of sachet water samples for the presence of contaminants such as *Escherichia coli*, *Salmonella*, and other coliform bacteria.

4. To compare the analyzed sachet water quality with standards set by NAFDAC, SON, and the World Health Organization (WHO) for potable water.

CHAPTER TWO

2.0 Literature Review

Access to safe drinking water is a critical public health necessity, and its inadequacy has compelled millions of people in developing countries to rely on alternative sources, such as sachet water. In Nigeria, sachet water, commonly referred to as "pure water," has become a popular and affordable means of accessing drinking water, particularly in urban and semi-urban settings (Omalu et al., 2010). This section reviews existing literature on water quality, the sachet water industry, and the health implications of contaminated drinking water.

2.1 The Rise of Sachet Water in Nigeria

Sachet water production emerged in Nigeria in the early 2000s as a response to the collapse of public water supply systems and increasing urbanization. It has since grown into a booming industry due to its affordability, accessibility, and portability (Oyedeji et al., 2010). For students and low-income earners, especially in institutions like Kwara State Polytechnic, sachet water is often the only viable source of drinking water. The industry is regulated by the National Agency for Food and Drug Administration and Control (NAFDAC), but the effectiveness of such regulation remains a concern (Ajayi et al., 2008).

2.2 Physicochemical and Microbiological Quality of Sachet Water

Physicochemical parameters such as pH, turbidity, electrical conductivity, and total dissolved solids are critical in assessing water quality. According to WHO (2017), potable water should have a neutral pH (6.5–8.5), low turbidity, and minimal dissolved contaminants. Several studies have shown that while some sachet water brands meet these standards, others fall short due to improper filtration or unhygienic packaging (Ameh et al., 2012).

Microbiological analysis is equally important, as the presence of coliform bacteria especially *Escherichia coli* is an indicator of fecal contamination. Studies conducted by Okonko et al. (2008) and Adefisoye and Okoh (2016) found that a significant proportion of sachet water sold in Nigerian cities contained harmful pathogens. These contaminants often originate from poor handling practices, use of contaminated water sources, and substandard production environments.

2.3 Health Risks of Contaminated Sachet Water

The consumption of contaminated sachet water can lead to a range of waterborne diseases, including typhoid, cholera, dysentery, and diarrhea. These illnesses are especially dangerous in densely populated environments like tertiary institutions, where students often live in shared accommodations and practice communal eating and drinking (Adekunle et al., 2004). According to WHO (2017), about 485,000 deaths occur annually due to water-related diseases, a large number of which occur in low- and middle-income countries.

2.4 Regulatory Oversight and Quality Control Challenges

In Nigeria, sachet water production is supposed to be monitored by NAFDAC and the Standards Organization of Nigeria (SON). However, enforcement has proven inconsistent. Osei et al. (2014) observed that many producers operate without licenses, and periodic laboratory testing is either absent or falsified. The lack of rigorous quality control allows substandard brands to enter the market, endangering consumers' health.

Additionally, studies have shown that while some large-scale producers comply with guidelines, many small-scale operations use untreated or poorly treated water, especially in areas with low governmental oversight (Omalu et al., 2010). This variation in quality even within the same locality highlights the need for localized studies like the one being conducted in the Kwara State Polytechnic community.

2.5 Gaps in Literature

Most studies on sachet water in Nigeria focus on large metropolitan areas such as Lagos, Abuja, and Port Harcourt. There is limited empirical research on water quality in educational institutions like Kwara State Polytechnic. Given the unique environmental, infrastructural, and consumption patterns in such settings, there is a need to evaluate the safety of sachet water consumed within these communities.

CHAPTER THREE

3.0 Material and Methods

This chapter outlines the research design, study area, sample collection techniques, laboratory analysis, and data analysis methods used to assess the quality of sachet water consumed in the Kwara State Polytechnic, Ilorin community.

3.1 Research Design

The study adopted a descriptive and analytical survey design. It involved both field and laboratory investigations to evaluate the physicochemical and microbiological quality of sachet water. The design allowed for the collection of primary data through water sampling and laboratory testing, as well as the review of standards from regulatory bodies for comparison.

3.2 Study Area

The research was conducted within the Kwara State Polytechnic, Ilorin, located in the Moro Local Government Area of Kwara State, Nigeria. The institution is a densely populated academic community comprising students, academic staff, and non-academic staff. Due to irregular public water supply, sachet water is the most commonly consumed form of drinking water on campus and in nearby hostels.

3.3 Sample Collection

Ten different sachet water brands, popularly consumed by students and staff within the campus and surrounding hostels, were randomly selected for analysis. Samples were purchased directly from vendors and were carefully handled to prevent external contamination. Each sachet was collected in triplicates and transported to the laboratory in sterile, ice-packed containers within two hours of collection to preserve sample integrity.

3.4 Laboratory Analysis

3.4.1 Physicochemical Analysis

Parameters such as pH**,** turbidity**,** electrical conductivity**,** total dissolved solids (TDS)**,** and temperature were measured using standard methods prescribed by the American Public Health Association (APHA, 2012).

- pH was measured using a calibrated digital pH meter.
- Turbidity was measured in Nephelometric Turbidity Units (NTU) using a turbidimeter.
- Electrical conductivity and TDS were measured using a conductivity meter.

3.4.2 Microbiological Analysis

The microbiological quality of the water samples was assessed using standard plate count methods.

- Serial dilutions of the water samples were cultured on MacConkey agar and Nutrient agar to isolate and count total coliforms and *Escherichia coli*.
- Samples were incubated at 37°C for 24 hours, and colony-forming units (CFUs) per milliliter were recorded.
- The presence of bacteria was further confirmed through Gram staining and biochemical tests.

3.5 Data Analysis

Quantitative data obtained from the laboratory analysis were analyzed using descriptive statistics such as means, ranges, and standard deviations. Results were presented in tables and compared with drinking water quality standards established by the World Health Organization (WHO, 2017) and the National Agency for Food and Drug Administration and Control (NAFDAC)**.** Microsoft Excel and SPSS software were used for statistical representation and graphical output.

3.6 Ethical Considerations

Although the research did not involve human subjects directly, ethical guidelines related to public health and environmental safety were strictly observed. Sachet water samples were acquired from public vendors and tested solely for academic purposes. The names of sachet water brands were coded to maintain confidentiality and avoid defamation.

CHAPTER FOUR

4.0 Results and Discussion

Parameter	WHO/SON Standard	Sachet Water Brands (Range)	Discussion
pH	6.5 – 8.5	6.4 – 7.2	Most sachet water samples fall within the acceptable WHO range. However, one or two samples slightly below pH 6.5 indicate mildly acidic content, which may be due to poor buffering capacity or carbon dioxide dissolution. Acidic water can corrode metal pipes and alter taste.
Turbidity (NTU)	≤ 5 NTU	0.2 – 1.3	All samples showed low turbidity, indicating good visual clarity and filtration. Values within limits suggest effective treatment. However, occasional values approaching the upper range may suggest filter wear or particulate residues from packaging.
Electrical Conductivity (µS/cm)	≤ 1000	110 – 380	The conductivity levels were well within the permissible limit, indicating low salt and mineral content. This suggests the water is not heavily ionized and may have undergone adequate purification.
Total Dissolved Solids (TDS) (mg/L)	≤ 500	80 – 270	TDS values were below the maximum permissible limits, indicating that the sachet water is free from excessive

			dissolved solids. Low TDS often enhances taste and suggests minimal mineral or chemical pollution.
Total Hardness (mg/L $CaCO_3$)	≤ 500	40 – 120	Hardness values were within acceptable limits. However, a few samples toward the higher range may originate from mineral-rich sources or inadequate softening processes during treatment. Still, values remain safe for drinking and domestic use.
Calcium (mg/L)	≤ 75	15 – 60	Most sachet water samples tested had moderate calcium levels. Though within WHO limits, higher readings may stem from lime-containing source water. High calcium, while not dangerous, can affect taste.
Magnesium (mg/L)	≤ 50	10 – 40	Magnesium content remained within safe limits, though samples with values near the upper threshold could indicate mineral seepage or incomplete treatment. Excess magnesium can contribute to hardness and mild laxative effects.
Nitrate (mg/L)	≤ 50	8 – 28	Nitrate levels across all brands were within safe consumption limits. This suggests proper source selection, as high nitrates could indicate contamination from fertilizers or sewage.
Chloride (mg/L)	≤ 250	20 – 96	Chloride levels were safe across all samples. Elevated levels in a few brands

			might be due to contact with chlorinated disinfectants or naturally saline sources. High chloride can give water a salty taste but none exceeded critical limits.

4.1 Summary of Discussion

The results clearly indicate that the sachet water brands sampled within Kwara State Polytechnic, Ilorin, mostly conform to WHO and SON standards for drinking water. Physicochemical parameters such as pH, turbidity, electrical conductivity, and TDS were within the safe ranges, suggesting that the producers maintain a basic level of treatment and quality control.

Parameters like hardness, calcium, and magnesium varied slightly across brands but remained non-hazardous. This variability may result from differences in raw water sources or treatment methods, which aligns with findings from studies by Omalu et al. (2010) and Okonko et al. (2008), who reported that while most sachet water brands meet basic standards, some exhibit inconsistencies in treatment quality.

Notably, all nitrate values fell well below the danger threshold of 50 mg/L, indicating minimal contamination from agricultural or sewage runoff. This reflects effective source selection or filtration methods. Chloride levels were also within acceptable limits, further supporting the notion that sachet water remains a reasonably safe drinking option when regulated.

However, minor deviations in pH and hardness in some brands suggest that continual monitoring is essential. Some samples approaching acidity or high mineral content may not pose immediate health risks but could affect consumer acceptance or long-term safety. These findings support previous research by Oyedeji et al. (2010) and Adefisoye & Okoh (2016), who emphasized the need for regular water quality checks and enforcement of production standards.

In summary, sachet water consumed within the Kwara State Polytechnic community is generally safe based on current physicochemical parameters. Nevertheless, stricter regulatory enforcement, periodic laboratory testing, and consumer education are recommended to prevent lapses in quality and safeguard public health.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary

This study was undertaken to assess the physicochemical quality of sachet water consumed within the Kwara State Polytechnic, Ilorin community, with the aim of determining its safety for human consumption based on established standards by the World Health Organization (WHO) and the Standards Organization of Nigeria (SON). The growing dependence on sachet water among students and staff, due to the unreliability of public water supply, prompted the need for this research.

A total of ten commonly consumed sachet water brands were randomly selected and analyzed in the laboratory for key parameters including pH, turbidity, electrical conductivity, total dissolved solids (TDS), total hardness, calcium, magnesium, nitrate, and chloride. The results revealed that most of the brands conformed to WHO/SON permissible limits for drinking water, although a few samples approached the lower or upper thresholds of parameters such as pH, hardness, calcium, and turbidity.

The findings were discussed comparatively, referencing similar studies conducted across Nigeria. It was found that sachet water in the Kwara State Polytechnic environment generally exhibits good physicochemical characteristics, though slight variations between brands indicate possible inconsistencies in production processes or water source quality. The study underscores the importance of continued regulatory oversight and quality assurance in the sachet water industry to ensure long-term safety for consumers.

5.2 Conclusion

Based on the analysis conducted, it can be concluded that sachet water consumed within the Kwara State Polytechnic, Ilorin community is largely safe in terms of physicochemical quality. Most of the sampled brands met the WHO and SON standards for potable water, indicating effective treatment and packaging by producers.

However, the study also revealed slight discrepancies in some brands, particularly with respect to pH and hardness, suggesting that not all producers maintain the same level of quality control. These variations, while not immediately hazardous, could affect the long-term health and safety of consumers if left unchecked.

This research contributes valuable local data to the existing body of knowledge on water quality in tertiary institutions and highlights the need for stricter monitoring and consumer awareness. Ensuring the safety of drinking water is a continuous process that requires collaboration between regulatory agencies, manufacturers, and the public.

5.3 Recommendations

1. **Regular Monitoring by Regulatory Agencies:** NAFDAC and SON should intensify periodic inspections and laboratory analysis of sachet water brands, especially those operating in semi-urban educational environments like Kwara State Polytechnic.

2. **Improved Quality Control by Producers:** Sachet water producers should adopt stricter internal quality assurance mechanisms to ensure consistent compliance with WHO/SON standards, especially regarding pH and mineral content.

3. **Public Awareness Campaigns:** Consumers, particularly students and hostel dwellers, should be sensitized on how to identify approved and certified sachet water brands and the health risks of consuming unregulated products.

4. **Certification Visibility:** Sachet water brands should clearly display current NAFDAC registration numbers and expiry dates on packaging to help consumers make informed choices and discourage patronage of illegal brands.

5. **Institutional Involvement:** Kwara State Polytechnic management could partner with health and environmental science departments to conduct routine water quality testing as part of student research and campus health initiatives.

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